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Primulina jiulianshanensis, a new species of Gesneriaceae from Jiangxi Province, China

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Abstract

Primulina jiulianshanensis F.Wen & G.L.Xu, a new species of Gesneriaceae from Jiulianshan National Nature Reserve of Jiangxi Province, China, is described and illustrated here. Molecular evidence showed it was sister to *P. wenii* Jian Li & L.J.Yan, while the morphological observation found clear differences between them, petiole, both sides of leaf blades, adaxial surface of the calyx lobes, corolla inside toward the bottom, bract margins covered glandular-pubescent hairs in *P. jiulianshanensis* (*vs.* no glandular-pubescent hairs in *P. wenii*); lateral bracts 4–9 × ca. 2 mm, the central one 2–5 × 1–1.5 mm, adaxially glabrous but sparsely pubescent at apex (*vs.* lateral bracts 14–16 × 2.5–3.0 mm, the central one 10–12 × 1.3–1.6 mm, all adaxially pubescent); calyx lobes 8–11 × ca. 2 mm, each side with several brown serrate teeth at apex (*vs.* 14–15 × ca. 2.5 mm, margin entire); filaments and staminodes sparsely yellow glandular-puberulent (*vs.* white, glabrous).

Keywords

Flora of Jiangxi, Jiulianshan National Nature Reserve, new taxon, *Primulina wenii*, taxonomy

* The authors contributed equally to this work.

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Introduction

The genus *Primulina* Hance (Hance 1883) in Gesneriaceae is mainly distributed in the mountainous areas of southern and southwestern China to northern Vietnam, especially in Karst landforms (Wei 2018; Xu et al. 2020b). Since it was redefined (Wang et al. 2011; Weber et al. 2011), many new species have been discovered and published. For example, ten new taxa of *Primulina* from China were reported in 2020 (Du et al. 2021). As of December 2022, about 240 species (including infraspecies, the same below) have been confirmed throughout the world, of which 224 species are distributed in China. So far, this genus is the largest genus of Gesneriaceae in China (POWO 2022).

Jiangxi Province is located in the mid-subtropical region of East China; the species number of *Primulina* is not very rich. After consulting references, checking herbarium specimens, and excluding the species that have been mistakenly identified, only 13 species of *Primulina* have been confirmed in Jiangxi Province (Peng et al. 2021). Three of them were discovered and published after 2011, which are *P. lepingensis* Z.L.Ning & M.Kang (Ning et al. 2014), *P. suichuanensis* X.L.Yu & J.J.Zhou (Zhou et al. 2016) and *P. inflata* Li H.Yang & M.Z.Xu (Xu et al. 2020a).

In April 2021, an interesting population of *Primulina* was found on a cliff of Danxia landform under the evergreen broad-leaved forest in Jiulianshan National Nature Reserve, Longnan City, Jiangxi Province. Morphologically, this species is similar to *P. wenii* Jian Li & L.J.Yan (Li et al. 2017) in some characteristics. For example, leaf blades are oblong or broadly rounded, corolla purple, and so on.

We collected the plants at the flowering and fruiting stage in the type locality to make specimens, and at the same time carried out botanical fine anatomical photography to observe carefully. We saw that the indumentum characters of petiole, leaf, bract, calyx, corolla tube, filaments, staminodes of this unknown species were obviously different from *P. wenii*, and the differences of two species' calyx lobes and bracts characters can help us easily distinguish them. In order to understand the phylogenetic placements of this unknown species in *Primulina*, ITS and *trnL-F* sequences of this species were amplified and included for phylogenetic analysis to examine the relationships of the putative new species.

Materials and methods

Morphological observation

All available specimens of *Primulina* were used and compared (i. e. those stored in the following herbaria ANU, HITBC, IBK, IBSC, KUN, PE), as was the material of *Primulina* from recent fieldwork by the authors' team in South and Southwest China. All the morphological characters, such as leaves, inflorescences, flowers and capsules, were observed and measured in the field. The description, measurements, shape, color

and other details given in this description are based on living plants and specimens. We examined distinguished morphological characters of the presumed new species and the compared one, *P. wenii*, under a dissecting microscope. We described this presumed new species using the terminology of Wang et al. (1990, 1998).

Sampling and DNA sequencing

We randomly selected one plant from the population to collect its leaves for a DNA experiment. Fresh leaf materials were preserved in silica gel for quick drying. Total genomic DNA was extracted from dried leaves using modified cetyltrimethylammonium bromide (CTAB) protocol (Doyle and Doyle 1987). ITS and *trnL-F* were amplified and sequenced following the methods of Möller et al. (2009) and Smissen et al. (2004), respectively. Besides, we downloaded the ITS and *trnL-F* sequences from GenBank for 188 *Primulina* species and two *Petrocodon* species. Species and GenBank accession numbers employed in this study are listed in Table 1.

Phylogenetic analysis

We assembled and aligned the newly obtained sequences and those from GenBank using MAFFT v.7.017 (Katoh et al. 2002) and subsequently corrected and combined the ITS and *trnL-F* sequences in Geneious 9.1.4 (Kearse et al. 2012). We used the Maximum likelihood (ML) and Bayesian inference (BI) analyses to do the phylogenetic analysis of the ITS and *trnL-F* matrixes, and the combined ITS + *trnL-F* sequences data-set. The two best supported tree topologies from maximum likelihood (ML) analyses of ITS and *trnL-F* were visually compared for topological incongruence. A conflict in tree topologies of each tree was considered significant when incongruent topologies both received bootstrap values ≥ 80% (Fu et al. 2022). The ML analyses were conducted using IQ-TREE 1.6.12 (Nguyen et al. 2015) with the GTR+R6 model and 1000 ultrafast bootstrap replicates. For BI analysis, we employed MrBayes v.3.2.6 (Ronquist et al. 2012) to obtain a maximum clade credibility (MCC) tree. Bayesian inference was performed using one million generations, four runs, four chains, a temperature of 0.001, 25% trees discarded as burn-in, and trees sampled every 1,000 generations (1,000 trees sampled in total) with GTR+I+G model.

Results

Phylogenetic analysis

The ITS matrix had a length of 782 characters, with 449 (57.4%) variable characters and 355 (45.4%) parsimony-informative. In comparison, the *trnL-F* matrix had a length of 836 characters, with 198 (23.6%) variable characters and 93 (11.1%) were parsimony-informative. The comparison of trees for ITS and *trnL-F* revealed no

Table 1. Species names and GenBank accession numbers of ITS and *trnL-F* DNA sequences used in this study.

Species name	Voucher number	ITS	*trnL-F*
Petrocodon ainsliifolius	CWH88	KF202291	KF202298
Petrocodon hancei	CIPeng22903	KY796057	KY796059
Primulina alutacea	YD07	KY394847	KY393441
Primulina argentea	YMBC	KY394848	KY393442
Primulina baishouensis	GXLG05	KY394849	KY393443
Primulina balansae	BALAN	MK747141	MK746274
Primulina beiliuensis	GXBLBC	KY394850	KY393444
Primulina beiliuensis var. *fimbribracteata*	SGQJ04	KY394851	KY393445
Primulina bicolor	SLHLCB	KY394852	KY393446
Primulina bipinnatifida	GXLG04	KY394853	KY393447
Primulina bobaiensis	BBGL01	KY394854	KY393448
Primulina bogneriana	WF7	MK747166	MK746225
Primulina brachytricha	DWDMCZ	KF498048	KY393450
Primulina brachytricha var. *magnibracteata*	KFC4193	MK369979	MK369994
Primulina brunnea	BRUN	MK747142	MK746275
Primulina bullata	GXJX06	KF498071	KY393451
Primulina cangwuensis	GXLG04	KY394853	KY393447
Primulina cardaminifolia	GXLB	MK747131	MK746255
Primulina carinata	NTBC	KY394858	KY393452
Primulina cataractarum	N1	MW900263	MW960358
Primulina chizhouensis	JXFY01	KY394860	KY393454
Primulina colaniae	WF8	MK747167	MK746224
Primulina confertiflora	GDYS05	MK747101	MK746253
Primulina cordata	HYH010	KC190200	KC190207
Primulina cordifolia	GXRA02	KY394863	KY393457
Primulina cordistigma	GDYCXZ	MK747118	MK746251
Primulina crassirhizoma	CJGL01	KY394864	KY393458
Primulina crassituba	HNSP	MK747147	MK746230
Primulina curvituba	GXHJ01	MK747137	MK746242
Primulina danxiaensis	P22865	JX506886	JX506778
Primulina debaoensis	DBGL01	KY394868	KY393462
Primulina depressa	DXS02	KY394869	KY393463
Primulina diffusa	PJGL01	KY394871	KY393465
Primulina dongguanica	DGBC	KY394872	KY393466
Primulina drakei	YNCP01	KY394873	KY393467
Primulina dryas	HKDMS	KY394875	KY393469
Primulina duanensis	DABC	KY394877	KY393471
Primulina eburnea	P22908	JX506891	JX506783
Primulina effusa	KFC4167	MK369976	MK369991
Primulina fengkaiensis	KFC4130	MK369975	MK369990
Primulina fengshanensis	KFC4195	MK369970	MK369985
Primulina fimbrisepala	P22863	JX506894	JX506786
Primulina fimbrisepala var. *mollis*	GXIB	JX506895	JX506787
Primulina flavimaculata	KFC3988	MK369974	MK369989
Primulina floribunda	DHGL01	KY394886	KY393480
Primulina fordii	LJM1207202	MG727881	MG727878
Primulina fordii var. *dolichotricha*	DHS01	MK747125	MK746247
Primulina gemella	GEME	MK747146	MK746254
Primulina glabrescens	GZLBSM	MK747132	MK746278

Species name	Voucher number	ITS	*trnL-F*
Primulina glandaceistriata	GXLCHW	MK747114	MK746256
Primulina glandulosa	GXPLCG	KY394887	KY393481
Primulina gongchengensis	GCGL01	KY394889	KY393483
Primulina grandibracteata	YNHK	MK747121	MK746266
Primulina guigangensis	GXGGBC	KY394892	KY393486
Primulina guihaiensis	GXLG036	KY394893	KY393487
Primulina guizhongensis	GXGZBC	KY394894	KY393488
Primulina halongensis	HLW01	KY394895	KY393489
Primulina hedyotidea	XWB	JX506905	JX506797
Primulina heterochroa	GXMES01	KY394898	KY393492
Primulina heterotricha	HNBT01	KY394899	KY393493
Primulina hezhouensis	HZXH	MK747143	MK746258
Primulina hiepii	WF2	MK747144	MK746223
Primulina hochiensis	GXIB	JX506903	JX506795
Primulina huaijiensis	GDHJ02	KF498127	KY393495
Primulina huangii	WF12	MK747138	MK746231
Primulina hunanensis	Xu11697	KU220602	KU220608
Primulina jiangyongensis	HNJY01	KY394902	KY393496
Primulina jingxiensis	LZXHGL01	KY394903	KY393497
Primulina jiuwanshanica	JWS	MK747116	MK746260
Primulina juliae	LJM1210011	MG727889	MG727873
Primulina langshanica	LSCZ	KY394907	KY393501
Primulina latinervis	XIN1	KY394908	KY393502
Primulina laxiflora	P22927	JX506910	JX506802
Primulina lechangensis	GDLC12	KY394910	KY393504
Primulina leeii	LSGL01	KY394911	KY393505
Primulina leiophylla	GXJX07	KY394912	KY393506
Primulina lepingensis	JXLP01	KY394913	KY394913
Primulina leprosa	GXMS055	KY394914	KY393508
Primulina lianpingensis	CHLT016	MH343910	MH344542
Primulina liboensis	GXJX08	KY394917	KY393511
Primulina liguliformis	GXIB	JX506912	JX506804
Primulina lijiangensis	GLS01	KY394919	KY393513
Primulina linearicalyx	KFC4141	MH032854	MH032841
Primulina linearifolia	GXNN01	KY394921	KY393515
Primulina lingchuanensis	LCXHGL01	KY394922	KY393516
Primulina linglingensis	LLBC	KY394923	KY393517
Primulina linglingensis var. *fragrans*	XHLLBC2	MK746285	MK746285
Primulina liujiangensis	LJGL01	KY394924	KY393518
Primulina lobulata	GDQX04	KF498054	KY393519
Primulina longgangensis	P22948	JX506916	JX506808
Primulina longicalyx	GXGL01	KY394927	KY393521
Primulina longii	XWB	JX506917	JX506809
Primulina longzhouensis	P22963	JX506918	JX506810
Primulina lunglinensis	GZXY04	KY394930	KY393524
Primulina lunglinensis var. *amblyosepala*	LCDE	MK747105	MK746281
Primulina lungzhouensis	GXJX10	KY394931	KY393525
Primulina luochengensis	LCWCGL01	KY394932	KY393526
Primulina lutea	1844	JX506921	JX506813
Primulina lutescens	PBLS01	MK747135	MK746263
Primulina lutvittata	KFC4149	MK369978	MK369993

Species name	Voucher number	ITS	*trnL-F*
Primulina luzhaiensis	HYH019	KC190197	KC190204
Primulina mabaensis	SZY02	KY394937	KY393531
Primulina macrodonta	GXIB	JX506923	JX506815
Primulina maculata	Xu11916	KU220604	KU220609
Primulina maguanensis	YNMG	MK747127	MK746267
Primulina malipoensis	YNMLP01	MK747123	MK746240
Primulina medica	GXPLCM	KY394940	KY393534
Primulina melanofilamenta	GXXA	MK747158	MK746277
Primulina minor	WXXH1	MK747160	MK746290
Primulina minutimaculata	GXLZ10	KY394941	KY393535
Primulina moi	SGWY03	KF498115	KY393536
Primulina mollifolia	GXESWC	KY394943	KY393537
Primulina multifida	DLXHGL01	KY394946	KY393540
Primulina nandanensis	GXJX02	KY393541	KY393541
Primulina napoensis	GXIB	JX506930	JX506821
Primulina ningmingensis	NMGL01	KY394949	KY393543
Primulina obtusidentata	GZJK01	KF498096	KY393544
Primulina ophiopogoides	GXFS01	KF498062	KY393545
Primulina orthandra	ZRBC2	MK747128	MK746286
Primulina parvifolia	GGSL01	KY394952	KY393546
Primulina pengii	W0397	KU220603	KU220610
Primulina petrocosmeoides	SHDBC	KY394953	KY393547
Primulina pinnatifida	MS02	KY394954	KY393548
Primulina polycephala	GDLZ06	KY394955	KY393549
Primulina porphyrea	DNGL01	KU173793	KU173799
Primulina pseudoeburnea	KY394958	KY394958	KY393552
Primulina pseudoglandulosa	GXYS06	KF498138	KY393482
Primulina pseudoheterotricha	XWB	JX506933	JX506824
Primulina pseudolinearifolia	JXY	MK747140	MK746280
Primulina pseudomollifolia	JMMXH1	MK747134	MK746244
Primulina pseudoroseoalba	JFHGL01	KY394959	KY393553
Primulina pteropoda	HNCJ01	KY394960	KY393554
Primulina pungentisepala	JEGL01	KY394962	KY393556
Primulina purpurea	ZHGL01	KY394964	KY393558
Primulina qingyuanensis	GDQX01	KY394965	KY394965
Primulina renifolia	GXDA02	KY394966	KY393560
Primulina repanda	GXBM03	KY394968	KY393562
Primulina ronganensis	GXRA01	KF498135	KY393564
Primulina rongshuiensis	GXRS01	KF498088	KY393565
Primulina roseoalba	LDGL01	KY394972	KY393566
Primulina rosulata	GXPL05	KU528874	KU528884
Primulina rotundifolia	OO3	KY394975	KY393569
Primulina rubribracteata	JH01R	KU173791	KU173797
Primulina sclerophylla	GXDA01	KY394979	KY393573
Primulina secundiflora	GZQZ	MK747119	MK746279
Primulina shouchengensis	GXYF02	KY394980	KY393574
Primulina sichuanensis	SCBC	MK747162	MK746264
Primulina dryas	HKDMS	KY394875	KY393469
Primulina sinovietnamica	Peng21956	MK369973	MK369988

Species name	Voucher number	ITS	*trnL-F*
Primulina spinulosa	GXFS02	KF498063	KY393576
Primulina subrhomboidea	GXYS02	KY395018	KY393577
Primulina subulata	GDYA01	KY395020	KY393579
Primulina subulata var. *guilinensis*	GXHYXH	KY394967	KY393561
Primulina subulatisepala	CQAYH01	MK747122	MK746246
Primulina suichuanensis	GDLC07	KY395021	KY393580
Primulina swinglei	GXRX01	KY395022	KY393581
Primulina tabacum	LZ01	KY395023	KY393582
Primulina tenuifolia	GXBM01	KY395024	KY393583
Primulina tenuituba	GZGY01	KY395025	KY393584
Primulina tiandengensis	GXTD03	KY395027	KY393586
Primulina tribracteata	GXFS04	KY395028	KY393587
Primulina tribracteata var. *zhuana*	1877	JX506952	JX506843
Primulina tsoongii	ZSGL01	KY395029	KY393588
Primulina varicolor	GXNP01	KF498086	KY393589
Primulina verecunda	LBJX01	KY395031	KY393590
Primulina versicolor	GDYD01	MK747155	MK746252
Primulina vestita	QZXT	MK747156	MK746282
Primulina villosissima	QXY01	KY395032	KY393591
Primulina wenii	WENI	MK747148	MK746284
Primulina wentsaii	GXLZ047	KY395033	KY393592
Primulina wuae	WSBC	MK747159	MK746265
Primulina xinningensis	GGGL01	KY394891	KY393485
Primulina xiziae	ZJHZ01	KY395038	KY393597
Primulina yangchunensis	GDYC01	KY395039	KY393598
Primulina yangshanensis	GDNX01	KY395040	KY393599
Primulina yangshuoensis	GXYS07	KY395042	KY393601
Primulina yingdeensis	YD03	KU528876	KU528886
Primulina yungfuensis	GXIB	JX506957	JX506848
Primulina zhoui	WF18	MK747104	MK746222
Primulina jiulianshanensis	WF217	OP243287	OP243283

significant incongruence topology and both indicated that *Primulina jiuyishanensis* is closely related to *P. wenii* (Suppl. materials 1, 2). Because the combined dataset resulted in a better-resolved tree with higher support values, we use the combined dataset to do the further molecular studies. The combined data-set was 1628 characters, with 653 (40.1%) variable characters and 452 (27.8%) parsimony-informative, including the indels in all matrixes. The undescribed species and *P. wenii* were sister groups [Bayesian posterior probabilities (BIPP) = 1.00, ML ultrafast bootstrap support values (UFBoot) = 100%], and we found 10 and 1 different sites in the ITS (totally 615 bp) and the *trnL-F* (totally 750 bp) sequences between them, respectively (Table 2). belonging to a strongly supported clade (BIPP = 0.99, UFBoot = 98%) included *Primulina crassituba* (W.T.Wang) Mich.Möller & A.Weber, *P. effusa* F.Wen & B.Pan and *P. lobulata* (W.T.Wang) Mich.Möller & A.Weber (Wang 1982, 1989; Weber et al. 2011; Pan et al. 2017) (Fig. 1).

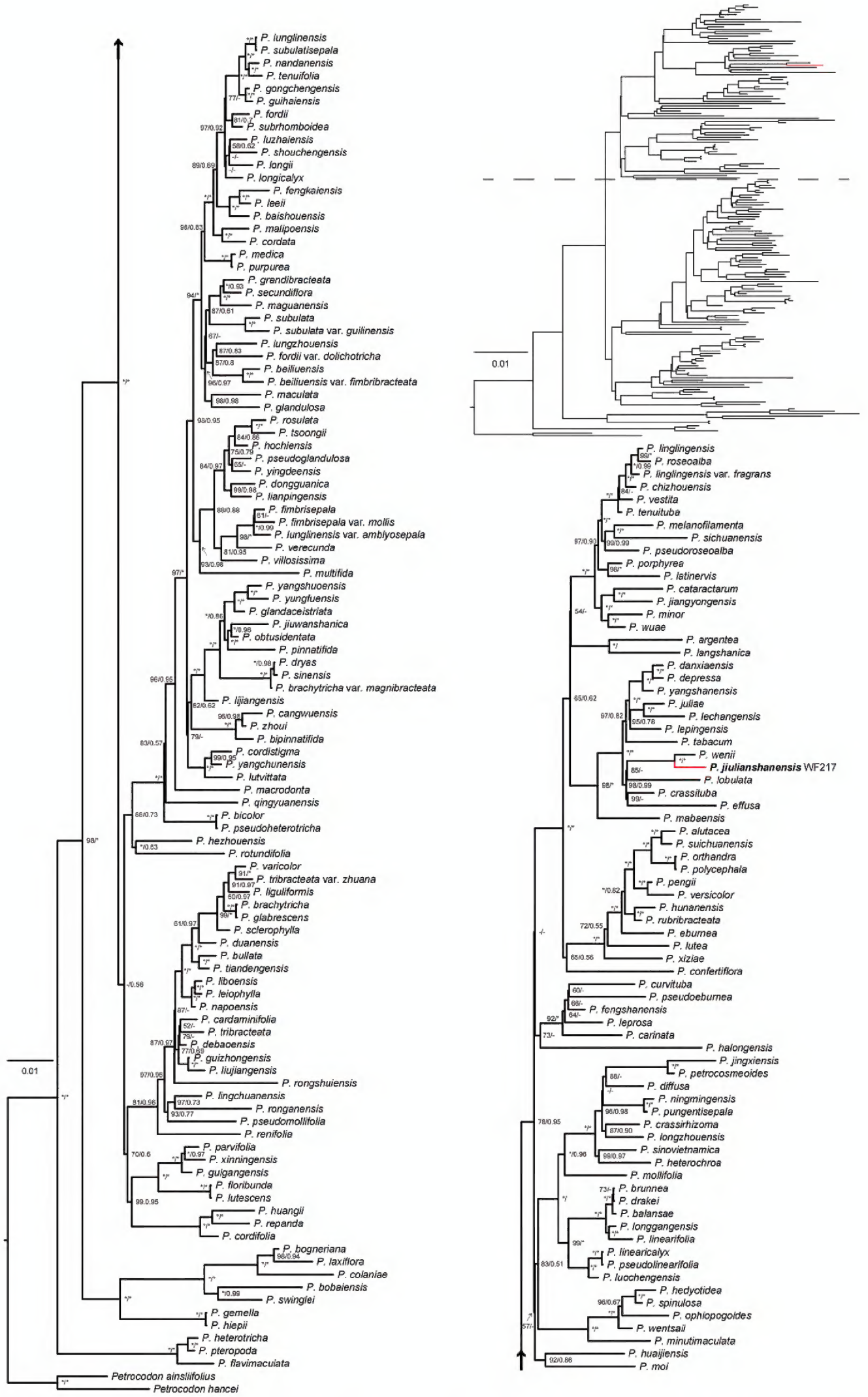

Figure 1. Phylogenetic tree of *Primulina* generated from maximum likelihood (ML) of combined *trn*L-F and ITS data-set. Numbers of each branch are support values in the order of UFBoot/BIPP. Stars indicate UFBoot = 100% or BIPP = 1.0. The dash (–) indicates a node with UFBoot or < 50% or BIPP < 0.5.

Table 2. Sequence differences of ITS and *trnL-F* regions between *Primulina jiulianshanensis* and *P. wenii*.

Species & marker	Sequences
P. jiulianshanensis ITS	1-CCCGAGAACATGTTTAAAACACGCTTGCGT-30
P. wenii ITS	1-CCCGAGAACATGTTTAAGACACGCTTGCGT-30
P. jiulianshanensis ITS	141-CGAGCGCCTCTCCGTCCTGGCTAAGTTCGC-170
P. wenii ITS	141-CGAGCGCCTCTCCGTACCGGTGAAGTTCGC-170
P. jiulianshanensis ITS	396-CGTTTTTTCCACGCTCAAAAGGTGTC–GGGGACGA-430
P. wenii ITS	396-CGTCTTTTCCACGCTCCAAAGGTGTCGGGGGAAGA-430
P. jiulianshanensis trnL-F	501-GTTCAAAAGTCCTTTATCTT-520
P. wenii trnL-F	501-GTTCAAAATTCCTTTATCTT-520

Taxonomic treatment

***Primulina jiulianshanensis* F.Wen & G.L.Xu, sp.nov.**
urn:lsid:ipni.org:names:77318694-1
Figs 2, 3

Diagnosis. This new species differs from *P. wenii* by the combination of the following characteristics: petiole, both sides of leaf blades, adaxial surface of the calyx lobes, corolla inside toward the bottom, bract margins glandular-pubescent (*vs.* what above-mentioned eglandular-pubescent in *P. wenii*); lateral bracts 4–9 × ca. 2 mm, the central one 2–5 × 1–1.5 mm, adaxially glabrous but sparsely pubescent at apex (*vs.* lateral bracts 14–16 × 2.5–3.0 mm, the central one 10–12 × 1.3–1.6 mm, all adaxially pubescent); calyx lobes 8–11 × ca. 2 mm, each side with several brown serrate teeth at apex (*vs.* 14–15 × ca. 2.5 mm and entire); filaments and staminodes sparsely glandular-puberulent (*vs.* glabrous). Detailed morphological comparisons with *P. wenii* are provided in Table 3.

Holotype. China, Jiangxi Province: Ganzhou City, Longnan County, Jiulianshan National Nature Reserve, growing in shady and moist cliffs in the forest, 24°34'8.9"N, 114°25'49.7"E, altitude ca. 440 m, April 20, 2021, *Guo-Liang Xu, JLSXGL-20210420* (Holotype IBK!; Isotype: KUN!)

Description. Herbs perennial, acaulescent, rhizome terete, 1–4 cm long, 0.8–1.5 cm in diam., leaves all basal, 4–8, petiole 10–40 × 4–13 mm, densely villous and very sparsely glandular-pubescent. Leaf blade oblong-elliptic or broadly elliptic, 4–13 × 4–8 cm, thickly chartaceous, more and less fleshly, adaxially pale green to dark green, densely white to light red villous and very sparsely glandular-pubescent, abaxially pale green, densely white villous and pubescent, and very sparsely glandular-pubescent, base apparently asymmetric but cuneate, margin irregularly obtuse-serrate, apex slightly obtuse, lateral veins 4–6 on each side, adaxially inconspicuously sunken, abaxially prominently raised. Inflorescence dichotomous cymes 2–4, axillary, 1–3-branched, 3–9-flowered or more; peduncle and pedicle green, erectly white or light red pubescent; peduncle 5–10 cm long, 2–3 mm in diam.; pedicle 5–15 mm long, 1–2 mm in diam. Bracts 3, lanceolate or spatulate, a pair on either side in same size, opposite, 4–9 mm long, ca. 2 mm wide, the middle one smaller, 2–5 mm long, 1–1.5 mm

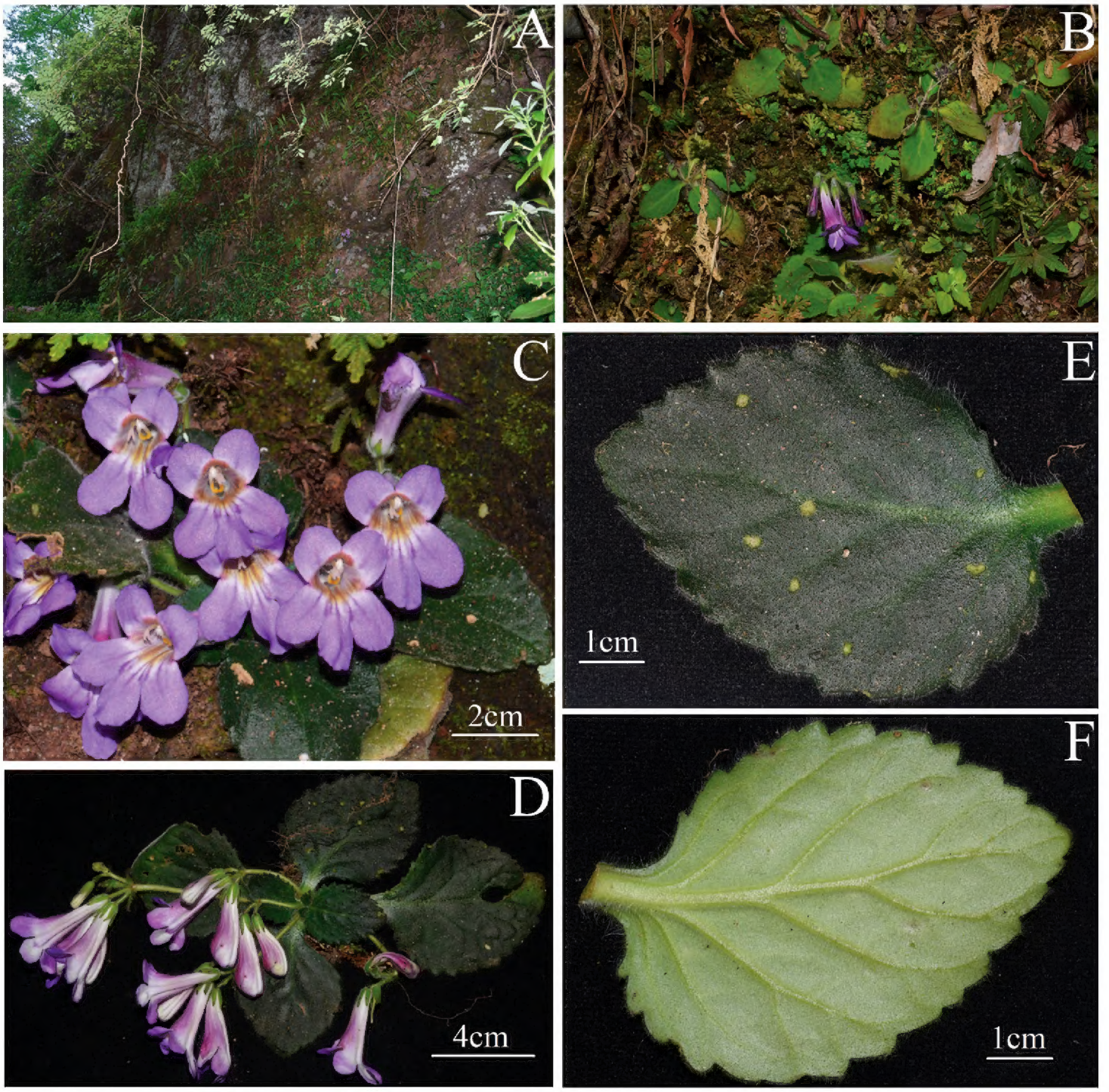

Figure 2. *Primulina jiulianshanensis* sp. nov. **A** habitat **B** population **C** plant in blooming **D** habit **E** adaxial surface of mature leaf blades and petiole **F** abaxial surface of mature leaf blade and petiole.

wide, all three abaxially white or reddish pubescent, adaxially glabrous but sparsely pubescent at apex, margin entire, ciliate and very sparsely glandular-puberulent, apex acute; bracteoles 3, shape and indumentum same as bracts, 2–5 mm long, 1–1.5 mm wide. Calyx 5-parted, lobes lanceolate, 8–11 mm long, ca. 2 mm wide, nearly equal, abaxially densely white or light red villous, adaxially sparsely white puberulent and glandular-puberulent, margin entire but each side of calyx lobes with 1–3 purplish brown crenate at the apex. Corolla pinkish purple to bluish purple, 3.6–4.0 cm long; corolla tube funnelform, 2.6–3 cm long, mouth 1.3–1.6 cm in diam., base ca. 5 mm in diam., outside densely glandular-pubescent, inside from the middle to the base sparsely glandular-puberulent, and the upper part of the corolla tube glabrous; corolla tube abdomen with two obviously longitudinal ridges, the upper part (close to the mouth) of the longitudinal ridge dark bluish purple, and the lower part (close to the bottom)

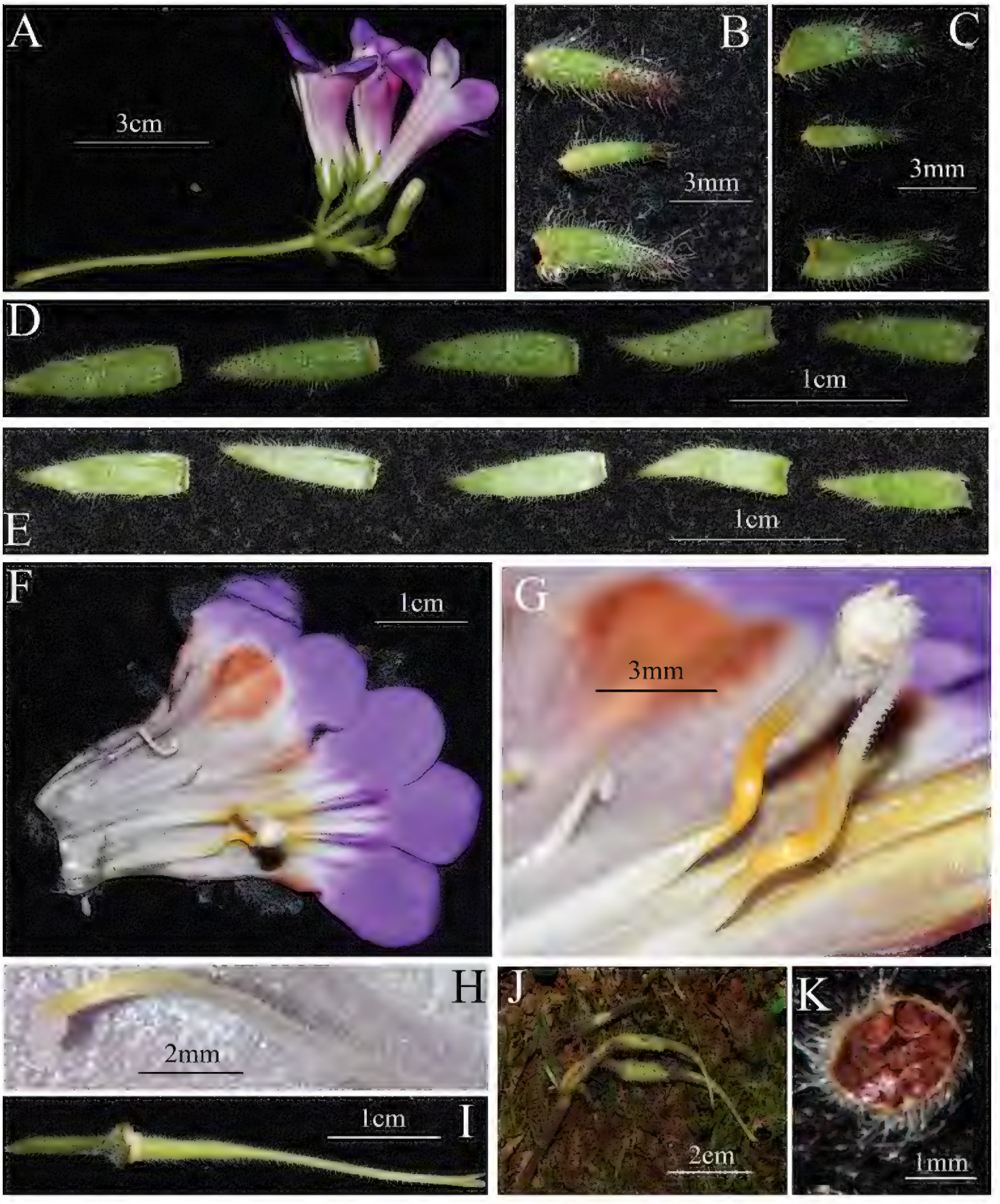

Figure 3. *Primulina jiulianshanensis* sp. nov. **A** cyme **B** adaxial surfaces of bracts **C** abaxial surfaces of bracts **D** adaxial surfaces of calyx lobes **E** abaxial surfaces of calyx lobes **F** opened corolla **G** stamens and anthers **H** one of lateral staminodes **I** pistil **J** immature capsules **K** transverse section of capsule.

changing into yellowish brown; a dark reddish-brown lump on the upper throat of the corolla tube inside and between upper lip lobes, ovate to spatulate, extending to the middle of the corolla tube, the lump densely glandular-puberulent; a narrow triangular thickened dark reddish-brown stripe extending to the middle of the corolla tube inside at each side of corolla tube and at the junction of the abaxial and adaxial lip;

limb distinctly 2-lipped, adaxial lip 2-parted to the middle, lobes broadly ovate to semicircular, apex round, 6–8 mm long, 6–9 mm wide at the bottom; abaxial lip 3-parted to near the base, lobes elliptical to oblong, 8–12 mm long, 7–9 mm wide at the bottom. Stamens 2, adnate to 1.8 cm above the base of corolla tube; filaments linear, yellow from middle to base but white upper half, 8–11 mm long, geniculate near the base, glandular-puberulent; anthers reniform, slightly constricted at the middle, densely villous and fewer glandular-puberulent; staminodes 3, yellowish, lateral ones ca. 6 mm long, adnate to 14 mm above the base of corolla tube, straight, linear, very sparsely glandular-puberulent, apex capitate, the central one ca. 1 mm long, adnate to 5–6 mm above the base of corolla tube, glabrous. Disc annular, ca. 1 mm high, margin undulate, glabrous, white. Pistil pale green, 2.8–3.2 cm long; style linear, 1.9–2.3 cm long, ca. 1 mm in diam., upper part densely glandular-puberulent, lower part densely glandular-puberulent and eglandular-puberulent, ovary oblong, ca. 10 mm long, ca. 2 mm in diam., densely villous and glandular-pubescent, parietal placenta. Stigma acute triangle to narrowly obtrapeziform, 2-lobed, ca. 3 mm long. Capsule linear, 2–4 cm long, parietal placenta, densely villous and glandular-pubescent.

Phenology. Flowering from April to May, fruiting from June to September.

Etymology. The specific epithet '*jiulianshanensis*' is derived from the type locality, Jiulianshan National Natural Reserve, Jiangxi Province, China.

Vernacular name. 九连山报春苣苔 (Chinese name); Jǐu Lían Shān Bào Chūn Jù Tái (Chinese pronunciation).

Distribution and habitat. We found three small subpopulations in Jiulianshan National Nature Reserve in Jiangxi Province, which are distributed in the shady and wet place on the cliffs under the evergreen broad-leaved forest in the reserve. And the new species is mainly acccompanied by *Begonia palmata* D.Don, *Utricularia striatula* J.Smith, *Selaginella moellendorffii* Hieron., *S. involvens* (Sw.) Spring, etc.

Conservation status. At present, only three small subpopulations with total ca. 300 mature individuals of the new species are known in the type locality, Jiulianshan National Natural Reserve, Jiangxi Province, China. The three subpopulations are stable because they are in the reserve. The known AOO and EOO of the new species are about 0.2 km^2 and 25 m^2, respectively. Thus, if considering its fewer individuals of three subpopulations, it should be temporarily assessed as Near Threated (NT), following the IUCN Red List Categories and Criteria (IUCN Standards and petitions committee 2022).

Notes. The mainly morphological differences are showed in diagnosis and Table 3. In addition, the insides of the corolla tube are also somewhat different. For example, at the junction of the abaxial and adaxial lip, there are two narrow triangular thickened dark reddish-brown stripes inside the corolla tube in *Primulina jiulianshanensis*, but there are only two bluish purple spots at the same places in *P. wenii*; at corolla tube abdomen of *P. jiulianshanensis*, the upper parts of the longitudinal ridges are dark bluish purple, and the lower parts are yellowish brown, but the longitudinal ridges inside corolla tube of *P. wenii* are all dark bluish purple; the lump on the upper throat inside corolla tube of *P. jiulianshanensis* is dark reddish-brown, but *P. wenii* is dark bluish brown(Li et al. 2017).

Table 3. Comparisons between the characters of *Primulina jiulianshanensis* and *P. wenii*.

Characters	*Primulina jiulianshanensis*	*P. wenii*
Petiole indumentum	densely villous and very sparsely glandular pubescent	densely villous
Leaf blades indumentum	adaxially densely white to light red villous and very sparsely glandular pubescent, abaxially densely white villous and pubescent, and very sparsely glandular -pubescent	adaxially densely pubescent and villous, abaxially densely appressed pubescent
Bract	lateral ones 4–9 × ca. 2 mm, the middle one 2–5 × 1–1.5 mm, all abaxially white or reddish pubescent, adaxially glabrous but sparsely pubescent at apex, margin ciliate and very sparsely glandular-puberulent	lateral ones 14–16 × 2.5–3.0 mm, the central one 10–12 × 1.3–1.6 mm; outside white pubescent and villous, adaxially white pubescent, margin entire and ciliate
Calyx lobes	adaxially sparsely white puberulent and glandular puberulent, margin entire but each side of calyx lobes with 1–3 brown crenate teeth at apex; lobes 8–11 × ca. 2 mm	adaxially sparsely shortly pubescent to nearly glabrous, margin entire, lobes 14–15 × ca. 2.5 mm
Filament	yellow from middle to base but white upper half, glandular-puberulent	white, glabrous
Staminodes	yellowish, lateral ones very sparsely glandular-puberulent	white, glabrous

The type locality of *Primulina wenii* is Rixi Township, Fuzhou, Fujian Province, while the type locality of *P. jiulianshanensis* is Jiulian Mountain, Jiangxi Province. Their type localities are separated by the Wuyi Mountains, and the two places are more than 500 kilometers apart. *P. wenii* has a narrow distribution range and is only recorded in Rixi Township, Fuzhou, Fujian Province (Li et al. 2017). This area is coastal and the climate zone of this region belongs to the typical subtropical marine monsoon climate. *P. wenii* grows in the limestone evergreen broad-leaved forest area with stable morphology. *P. jiulianshanensis*, grows on the rocks under the evergreen broad-leaved forest in Jiulianshan Nature Reserve, which is a typical Danxia landform. The soil forming rock are mainly sandstone and conglomerate in Jiulianshan Nature Reserve, which has a subtropical monsoon humid climate. The morphology of the *P. jiulianshanensis* in three subpopulations is also relatively stable. Therefore, considering the differences in molecular, morphological, and habitats between *P. jiulianshanensis* and *P. wenii*, they should be classified as two different species.

Except for a few species, such as *Primulina fimbrisepala* (Hand.-Mazz.) Yin Z.Wang, *P. eburnea* (Hance)Yin Z.Wang, *P. tenuituba* (W.T.Wang) Yin Z.Wang, *P. juliae* (Hance) Mich.Möller & A.Weber, most of the species of *Primulina* are narrowly distributed and endemic. Among the known species worldwide, more than 170 species are endemic to Karst areas in southern to southwestern China and to northern Vietnam (Wei 2018; Xu et al. 2020b). However, the diversity of *Primulina* in the Danxia landform has not been well understood so far (Yu et al. 2019). For example, the new species, *P. suichuanensis*, was found in the Danxia landform in Jiangxi Province (Zhou et al. 2016). It should be noted that a new provincial record for *Primulina wenii* from Jiangxi Province was discovered in Jiulianshan Nature Reserve (Liao et al. 2020). However, we carefully examined the voucher specimen (No. PVHJX-05557, stored in GNNU), and we noted that the voucher was collected from the same subpopulation of *P. jiulianshanensis* from the same site in Jiulianshan Nature Reserve. Further, we found there are many incon-

sistencies between the morphological description from the article (Liao et al. 2020) and the corresponding voucher specimens. Thus, this species' new provincial record of *P. wenii* in Jiangxi province is a mistaken identification. Lastly, none of the close relatives of *Primulina* are morphologically similar to this new species found in Jiangxi (Fig. 1). Thus, the new taxon is not easily confused with the others in this province.

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Supplementary material 1

The tree of the trnL-F plastid marker for *Primulina* species

Author: Zheng-Yu Zuo

Data type: (phylogenetic, genomic, tree)

Explanation note: The *trnL-F* plastid marker and the ITS nuclear marker separately and discuss any incongruences between the two markers, particularly with respect to the position of the new species.

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Link: https://doi.org/10.3897/phytokeys.226.96351.suppl1

Supplementary material 2

The tree of the ITS nuclear marker for *Primulina* species

Author: Zheng-Yu Zuo

Data type: (phylogenetic, genomic, tree)

Explanation note: The *trnL-F* plastid marker and the ITS nuclear marker separately and discuss any incongruences between the two markers, particularly with respect to the position of the new species.

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